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ABSTRACT

Information supplied in this bulletin stems from a review of the process the Creswell (Oregon) School District used in adopting its own energy conservation measures and in successfully applying for a construction grant for energy-efficient buildings. A number of questions that school districts may have in attempting to establish energy conservation programs are answered. Discussed are ways of finding out what assistance is available from state and federal government agencies, how a district can become eligible for National Energy Conservation funds, steps for initiating a districtwide energy conservation program, and what is involved in a preliminary energy audit. Basic tools of financial analysis used in the economic evaluation of energy conservation measures are explained. The appendix includes a glossary of terms commonly encountered in reading energy materials. Other topics discussed are inservice training materials and the role of a district energy coordinator as part of the school district's staff. The bulletin also details the incorporation of energy conservation material into a school curriculum. (Author/MLF)

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OSSC BULLETIN

ENERGY CONSERVATION: WHAT SCHOOLS CAN DO NOW

by
Stuart Young
and
Jim Richmond

Oregon School Study Council
Vol. 23, No. 7
March 1980

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PREFACE

Energy conservation challenges have just begun. School districts face huge increases in fuel costs which will demand their considered reaction.

Where should schools start with energy conservation? What assistance is available from the state or federal government? How might a district-wide energy conservation program be initiated? How can a district become eligible for National Energy Conservation funds? What is involved in a preliminary energy audit?

Dr. Stuart Young, Superintendent, and Jim Richmond, teacher and District Energy Coordinator in the Creswell School District, have prepared this *Bulletin* to assist with the above questions. Within the past year the Creswell School District has applied for and received a competitive construction grant for energy-efficient buildings. In addition, the district made a commitment to include the "energy-efficient construction program" in its curricula. Inservice training on materials available for classroom instruction has been offered to each school faculty by the district energy coordinator. He also has generated a library of materials for use by teachers at various grade levels. Creswell students recently set up exhibitions at the statewide Energy Awareness Day in Oregon.

This *Bulletin* by Stuart Young and Jim Richmond will be a valuable resource for districts facing the challenges of energy conservation.

Kenneth A. Erickson
Executive Secretary
Oregon School Study Council

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THE INTEREST IN ENERGY CONSERVATION

The growing interest in energy conservation is easily understood in light of comments made recently by Paul Salmon, Executive Director of the American Association of School Administrators.

> "We haven't begun to see energy cost escalation -- for every dollar budgeted for energy today, schools will need six (dollars) by 1989."

This concern also can be understood apart from a purely economic point of view. Historically schools have been asked to react to a variety of social and national concerns.

Because of the need to limit energy use, schools share the responsibility of educating tomorrow's consumer regarding the necessity of conservation and how this may be accomplished.

Reasons for Focusing on Conservation

There are three reasons why schools should focus on increasing the interest in energy conservation:

1. The development of lifelong conservation attitudes for tomorrow's citizen,
2. The imposition on public schools of recently developed federal guidelines and mandates,
3. The availability of substantial government funds for districts willing to take steps to conserve energy.

People of all ages are getting the message: Our nation has too few energy resources, too rapid a rate of energy consumption, and constantly escalating prices. In addition, little has been done to ensure that domestic energy production keeps up with domestic need. Educators face an obligation to instruct citizens and consumers about the realities of energy scarcity and costliness.

Why Student Interest? Lifelong Learning Aptitudes

If it cost a dollar for gas to get to school today, try to predict what it will cost today's students when they enter the work world. Technology may be a solution, but it also is a definite part of the problem, for technology spawned the multitude of devices that "eat up" our energy. Educators must prepare students for lifelong contact with an ever growing energy problem. Whenever possible students should be allowed to take an active role in conservation and energy awareness within the district.

Opportunities for energy education are as diverse as the schools' curriculum offerings. Curriculum materials for energy education now exist at all grade levels. The National Science Teachers Association and the U.S. Department of Energy have a variety of materials for all grade levels suitable for use in science, math and social studies classes. (See appendix for addresses to obtain these materials.)

The Creswell School District's successful application for vocational grants helped to create energy-related activities for shop classes. These include design and construction of devices such as solar hot water systems and an attached greenhouse for the vocational agriculture program. Additional grants for educational programs are currently being offered by the State Department of Education and more are forthcoming. Later in this monograph we will discuss ways to involve teachers in energy education. The necessity of energy education programs today must be recognized by all responsible for the curriculum development as well as for school district resources.

If persuading teachers to alter traditional curricula and infuse energy education is sometimes difficult, involving students in these "new"

ideas certainly is not! Given a choice between putting some pieces of plumbing together or building a solar system to learn a plumbing unit, students choose the solar system every time!

Why Management Interest? Federal Mandates

An obvious reason for school district interest in energy conservation is the Emergency Building Temperature Restrictions Regulations. All districts should have these regulations and compliance forms. The regulations went into effect on July 16, 1979. Due to the possibility of $5,000 or $10,000 fines, as well as the very real opportunities for financial savings all administrators should be aware of these regulations. If other districts are like ours, however, some teachers will wear coats to class and complain of the cold. Careful examination of these regulations reveals that the 65°-78° temperature range can be achieved legally without sacrificing comfortable learning environments, although some adaptation will be necessary. Instead of seeing these regulations as an example of government interference in "our business," we should look on them as an opportunity to reduce district energy costs and develop mechanisms for monitoring future increases in energy costs for heating, cooling, and lighting. For a more complete explanation of these regulations, consult the pamphlet that accompanies the compliance forms and certificates. This pamphlet is available from the Region X office of the Department of Energy at 915 Second Avenue, Seattle WA, 98174 or phone (206) 442-7285.

Only an overview of the regulation principles will be offered here. These regulations include specific rules for exemptions, modifications and special systems techniques that are important for all concerned with the maintenance and operation of school energy systems. For example,

all elementary schools that house only grades one through six are exempted from the regulations. In the case where other grades are taught in the same building, some regulations would apply, but only if the areas where the classes are taught are on separate systems. In all cases where separate systems are involved, administrative offices should conform to the regulations.

Temperature systems are classified as either simple or compound (integrated) types. A simple system is one which only performs one function, either heating or cooling. Compound systems are those which may both cool and heat spaces. (A more thorough explanation of terminology is offered later in this monograph.) An acquaintance with the terminology of heating and cooling is important in the understanding and compliance with these regulations. If a district has a heating specialist or engineer, such persons are the best resource available for interpreting and applying the regulations. If a district is contemplating application for assistance grants it may be desirable to employ an engineering firm.

It is improbable that federal mandates on public building energy consumption will disappear. In the face of ever increasing energy costs and scarcity school districts should expect more demands to reduce expenditures for heating and cooling of school buildings. The district that is dedicated to reducing energy consumption will effect financial savings and gain opportunities for grant assistance to improve existing energy systems.

<u>$aving Dollar$</u>

Another reason for school district interest in energy conservation is

almost axiomatic: Conserving energy will save money. School districts need to control escalating budget costs. By reducing energy costs educators are responding to a present and future societal need.

Federal Assistance Available

The growing awareness of energy as a priority government concern means money is being made available to improve energy usage. While each district may not be able to allocate substantial monies for remodeling or improving facilities, it can begin actively to position itself for assistance money. With escalating energy costs and budgets difficult to pass, a school system can say it is taking definitive steps to cut energy costs and receive federal assistance in making facility alterations.

As energy costs continue to rise each district will be forced to examine these ballooning costs and eventually make necessary facility changes. Since money now is available for making energy related changes, school districts that do not make an attempt to compete for funds or take steps to reduce current energy consumption may be put in the position of explaining to their communities why they are footing 100% of the renovation bills while other districts may be receiving assistance.

Immediate Benefits Derived

Each district will not automatically receive large amounts of money from federal sources. However, the potential for receiving assistance is real and an outline of the process a district goes through to be eligible will increase the awareness of how to streamline current operation and gain both immediate and long-term savings.

A good example of a funding project that will provide immediate benefit

in terms of awareness and savings is the current National Energy Conservation Policy Act (NECPA) of 1978 which authorizes matching funds for assistance to schools. The result of this four-level funding process is a potential 50% federal match for approved energy conservation measures. Components of the grant will be delineated later in the *Bulletin* but include:

Level I - Preliminary Energy Audits (PEA)

An information gathering survey not requiring on-site audit or outside assistance. This is the Preliminary Energy Audit for Schools, Hospitals, Local Government and Public Care Institutions which you have probably filled out already in May of 1979.

Level II - Energy Audit

A more site-specific review of facilities requiring a review of maintenence and operating procedures and opportunities for Energy Conservation Measure (retrofit) by persons who have Oregon State Energy Auditor Certificates.

Level III

An on-site, detailed energy analysis by a registered engineer or engineer/architect team. The result is to give a careful estimate of Energy Conservation Measures (ECM's), the costs, the expected savings and the payback period of each.

The Energy Audit Checklist forms used in Level II will be used for this analysis.

Level IV - Energy Conservation Measures

Grant funds will pay up to one-half the cost of approved Energy Conservation Projects (retrofit).

The NECPA provides funds to be administered locally by the Department of Energy. Whether a district proposal is funded or not, by taking Level I, II, and III steps, (necessary to qualify for matching funds) the district will have compiled valuable information that may be put to use immediately to reduce energy costs.

Because energy is such a timely national topic, the potential for future grants and federal assistance can be anticipated. Districts completing energy surveys now place themselves in a preferred position by being prepared when future energy-related programs are established.

SETTING A DISTRICT-WIDE ENERGY CONSERVATION PROGRAM IN MOTION

Commitment

Support and leadership of top school administrators are essential for initiating a district-wide energy conservation program. Commitments need to be encouraged at many levels throughout the educational system. Certainly, the superintendent, in providing guidance to the school board, must weigh a multitude of factors in determining the timing and ability of the district to implement an energy program. Factors such as initial start-up costs, current district short and long-range projects, time, available personnel, and potential payback period following the completion of energy conservation renovation must be considered.

In addition, the educational value of energy awareness programs for students in terms of developing a lifelong attitude and having energy-saved dollars available for other parts of the educational program should be considered.

Once the superintendent and school board have made a commitment to energy conservation, they can begin to orchestrate a joint commitment to conserve energy.

Steps Following Commitment

Following joint agreement on need, one of two immediate directions can be taken. One direction will make a district competitive for available federal monies as well as provide immediate information for reducing district energy costs. This means, however, pledging some initial capital outlay. The other direction is to focus on data collection of district energy consumption which requires minimal capital expenditure.

Following are some logical steps that may be included. While many steps overlap, the suggested order for implementation should be helpful.

DIRECTION I	DIRECTION II
Prepare District to Compete For Available Federal Money	Collect Available Resource Material and Develop Own Energy Conservation methods
Seek estimated cost for private firm to conduct an energy audit.	Identify key person(s) at district/building level with interest and organizational skills to act as DEC (District Energy Coordinator).
Provide school board with information and have budget committee place requirement in budget.	Begin to review available resource material.
Identify key person(s) at district/ building level with interest and organizational skills to act as DEC (District Energy Coordinator).	Share with other district administrators the importance of conserving energy.
Have DEC begin collecting relevant resource material from federal and state sources.	Identify immediate methods for reducing energy costs at building levels.
Send DEC to Energy Workshop.	Provide some in-service time for DEC to address building staff to address daily building consumption.

DIRECTION I	DIRECTION II
Prepare District to Compete For Available Federal Money	Collect Available Resource Material and Develop Own E.C. Methods
Have completed energy audit presented to school board.	Provide custodial checklist related to conserving energy in each building.
Explore matching/non-matching energy related program grants.	Share with community through the news media steps the district is taking to reduce energy consumption.
Use energy audit to identify methods for reducing energy costs at building level.	Explore matching and non-matching grants.
Provide in-service time for DEC to address building staff regarding daily classroom centers.	Develop resource material center and space for teachers.
Provide custodial checklist related to conserving energy in each building. (See Appendix)	Organize energy conservation contests between schools.
Share with community through the news media the steps being taken to reduce energy consumption and promote energy awareness.	Monitor monthly comparison of energy consumption.
Organize energy conservation contests between schools.	
Develop resource materials area and dispersion system for teachers.	
Monitor monthly comparison of energy consumption from previous years.	

Personnel

Establishing a district energy coordinator position is essential for initiating and keeping a program moving. It is important to find the right person for this position since responsibilities will be diverse. Look for these characteristics in a DEC.

- ▶High interest in energy conservation
- ▶Belief that conserving energy is essential
- ▶A motivated self-starter
- ▶Writing ability (the person might be used to help develop future grants)
- ▶Communication skills (the person will present materials at in-service time to staff at levels 1-12 as well as classified personnel).
- ▶Respected by fellow educators

The district also needs to consider committing resources to assist the DEC.

- ▶Is additional salary money available?
- ▶Are there possibilities of an extended contract?
- ▶Is there funding for the position through grant monies?
- ▶Can teaching load be reduced to provide time for a staff member to perform DEC duties and responsibilities?
- ▶Can some clerical assistance be provided?

Is there space for resource materials and a system of distribution? There may not be immediate money available to assist a DEC; however, a common cause commitment to increase energy awareness may still be reached.

General Guidelines for the District Energy Coordinator

•The District Energy Coordinator (DEC) - Description

The DEC should be expected to pursue both directing conservation

efforts and providing resources and encouragement for teachers to infuse energy awareness education into the existing school curriculum. Since this will involve dealing not only with teachers from kindergarten through high school but with the school custodial staff as well, it is essential that the DEC have both some public relations skill and the firm support of the administrative staffs. A teacher interested in energy topics should be chosen whenever possible, but interest alone is not necessarily enough.

•DEC Training

If the DEC is selected from the teacher ranks without much background in energy conservation and education, many opportunities for training exist. These include both local and statewide possibilities of: CC Solar and Energy Classes, neighborhood conservation programs, Department of Energy seminars and special training sessions for school people, and Division of Continuing Education and Personnel Development Center programs. Another area of training important in obtaining federal funds is that of grant writing.

•DEC Role in District Conservation Efforts

Typical efforts in conservation begin by offering inservice sessions to teachers covering topics such as thermostats and room systems, the importance of reporting heating, lighting, cooling and ventilating system malfunctions to the custodial staff IMMEDIATELY, identifying drafts, and asking teachers for their suggestions and needs. Following state guidelines, a major survey of the HVAC (heating, ventilating and air-conditioning systems) for efficiency and state of maintenance should be completed. Having the survey done by an engineering firm and then certified by the state, is one step needed to qualify for the upcoming federal assistance. In Creswell the DEC also offers weatherization services to individual classrooms by utilizing the vocational construction program in energy efficiency. Classes are shown how to caulk and apply weatherstripping and given tools and supplies to do their own classrooms. Every effort to save energy should be examined for ways to involve students directly in energy conservation.

•DEC Role in Energy Education Efforts

The DEC should serve as a resource to other teachers who may need to locate curriculum materials, activity guides, films and other teaching resources. Besides State of Oregon publications and resource guides, excellent bibliographies are becoming available for teachers. (Addresses for organizations providing such materials are available in the next section, Getting Started.) Special efforts should be directed at consumer-oriented courses where social studies, shop and science teachers can make immediate use of ideas for energy education. Other excellent resources are the utility companies which offer film, media, and speaker programs on energy.

Their presentations must be viewed with an awareness of their natural bias, but can be most helpful in a total curriculum. Teachers need to be aware that material is available for the asking.

The DEC should examine district competencies and program goals so an energy program which meets the needs of tomorrow's citizens can be implemented. At Creswell, through a construction grant, a resource library and multi-media center for energy education were established through just such a program of evaluation.

Getting Started - Currently Available Resources

To begin conservation and energy education may require more information than this monograph can offer, but other help is available. City or county governments may have energy specialists or special energy departments. City or county offices of Appropriate Technology may offer information and special programs useful to school districts. At the state level, both the Department of Energy and the Department of Education can offer assistance in energy education and conservation. (Claudia McDuffie serves as the State Department of Education Energy Specialist and Dave Philbrick heads one of the Department of Energy divisions applicable.) It is important to realize when dealing with state and local governments that their responses to the challenges of the energy problem are in a state of flux. The mandates, grants and regulations of the federal government have far-reaching effects on state and local offices that deal with energy problems.

On the federal level there are a variety of resources for administrators. Particularly useful is the Energy and Education Action Center of the U.S. Office of Education. The Center publishes materials that relate to resources

in education including a "Selected Guide to Federal Energy and Education Assistance" which is a must for each district. This guide lists departments of the federal government which offer financial assistance for energy-related education problems, the amounts available, and how to apply for such assistance. To obtain this publication and others, write or call:

Dr. Wilton Anderson
Director, Energy and Education Action Center
Room 514 - Reporters Building
300 7th Street SW
Washington, D.C. 20202 phone: (202) 472-7777

Another important resource is the:

Technical Information Center
Box 62
Oak Ridge, TN 37830

The center publishes brochures on all aspects of energy use and generation. For futher resources refer to the appendix section "Locating More Information."

PRACTICAL TOOLS FOR UNDERSTANDING ENERGY ISSUES AND TERMINOLOGY

The following sections are included to help individuals understand concepts related to energy conservation and to make it easier to decide what can be feasibly accomplished by an organization.

Tools highlighted in the following sections include:

--basic terminology;
--financial evaluation;
--procedure with formulae and examples that relate to energy evaluation and savings;
--audit techniques for laypeople.

Basic Terminology

Events often create new words. The appendix includes a glossary of such terms commonly encountered in reading energy materials. If architects and engineers seem to speak a foreign language ask them to explain what they talk about. It is necessary that you understand references to energy systems and devices to be informed on what would be best for your schools.

Financial Evaluation Procedures

Energy conservation opportunities (ECO's) which generate benefits greater than costs without sacrificing product quality are generally profitable. Those which require little more than optional changes that can be made at negligible cost clearly fall in this category. Many ECO's, however, require an initial capital outlay which must be amortized by the energy savings generated over their expected lifetime. Some ECO's which might have been marginal investments before the price of fuels and electricity began their rapid increase are now economically justifiable. An explanation of the basic tools of financial analysis used in the economic evaluation of ECO's follows.

Sound, consistent economic criteria for evaluating energy conservation opportunities are important. Before any investment is undertaken some quantitative measure of profitability is desirable so that the investment's expected return can be compared with alternate investment opportunities. Investment decisions are based on more than simple rates of return. Factors such as risk, cash flow, taxation schedules, preference between long and short-term investments, and others should be considered as well. Since these factors may vary greatly among firms, they will not be considered directly here.

● First Level Measures of Performance

While many energy conservation opportunities may be found during a close examination of plant and operations, some can be quickly rejected because of a low or negative return on investment. First level measures of performance can be useful in screening out such ECO's without the application of more sensitive second level measures. In general, however, first level measurements should not be used for justifying major investments for energy conservation projects since these measures do not reflect the time value of money. Because first level measurements, such as "payback period" and "return on investment," are often referenced and useful for screening candidate investments, it is desirable to show how they are computed and why they are not complete.

The information needed to calculate these performance measures is as follows:

INV - Investment
AOC - Annual Operating Cost (if any due to investment)
AFS - Annual Fuel Savings
PFP - Projected Fuel Price
EL(n) - Estimated Lifetime

Investment is the estimated dollar cost of labor and materials required to implement the scheme. The other four items determine the annual benefit stream. (Salvage value of the investment is disregarded here.)

Projected fuel price represents an average fuel price during the estimated lifetime of the investment. The use of current fuel prices will result in lower total savings than can be reasonably expected, inducing a bias against energy conservation investments.

At this point, the net annual saving is defined for application in forthcoming equations and discussion:

◉ Net Annual Savings - S = (AFS x PFP) - AOC

A. *Payback period* (PP) is defined as the investment divided by the net savings, or

$$PP = \frac{INV}{(AFS \times PFP) - AOC} \quad \text{or} \quad \frac{INV}{S}$$

The payback period is then compared to the expected lifetime of the investment in order to make some rough judgment as to its potential for recoupment. A payback period of less than one-half the lifetime of an investment would generally be considered profitable where the lifetime is ten years or less.

The pay back period as a measure of performance gives rise to problems, however. For instance, dollars saved in future years are credited the same as dollars saved in current years and comparisons between alternative investment opportunities of different lifetimes cannot be made.

B. *Return on Investment* (ROI) is somewhat superior to the above because it takes into account the depletion of the investment over its economic life by providing for renewal through a depreciation charge. Using a straight line depreciation charge (DC) where $DC = \frac{INV}{n}$ the present return on investment can be calculated using

$$ROI - \%/yr = \frac{S-DC}{INV} \times 100\%$$

ROI has the advantage of putting investments with different life expectancies on a comparable basis. It is frequently used in the financial analysis of potential investments because of its simplicity of calculation. Where the rate of return appears small, however (say less than 20%), second level measurements are called for.

◉ Second Level Measures of Performance

Second level measures of performance are those which incorporate an allowance for the time value of money, generally in the form of a discount factor. Because of alternative investment opportunities, a dollar held today is worth more than a dollar held in some future time period. The internal rate of return on the best available investment alternative is generally considered to be the appropriate discount rate for evaluating new investment opportunities, unless this rate is below the true borrowing rate when a new investment needs to be financed. In this case, the discount rate must be at least as high as the borrowing rate.

While appropriate discount rates may differ widely in different industries and even among firms within the same industry, corporate discount rates usually run between 10-20% or higher. This, again, is equivalent to saying that such a return can be realized elsewhere and thus for a new investment to be justified it must yield a return somewhat greater than this. It should be noted that profits generated by energy savings are generally taxed at the same rate as profits earned elsewhere within or outside of the firm, affirming the need for an equivalent discount rate for energy saving projects.

Several second-level measurements for evaluating ECO's are available. The following two will be presented and discussed:

Benefit/cost analysis.
Time to recoup capital investment.

A. *Benefit/cost ratio* (BCR) requires the direct comparison of the present value benefits (savings) generated by a given investment with its costs. Generally this is formulated in terms of a benefit/cost ratio (B/C). A ratio greater than unity implies that the expected net benefits (properly discounted and summed over the lifetime of the investment) will exceed the initial costs and therefore such an investment is profitable. Likewise a benefit/cost ratio less than unity implies that such an investment is not profitable. As an absolute measure of the profitability of an investment this is generally considered superior to all others.

   The stream of benefits, or net savings (S) can be expressed in terms of present value (PV) by using a discount rate (D) and summing the benefits over the expected lifetime (n) of the project. If this present value is greater than the first cost of the investment, the project is profitable.

$$V = \sum_{n=1}^{n} \frac{S(1+S\%)^n}{(1+INV)^n} \qquad BCR = \frac{PV}{INV}$$

B. *Time to recoup capital investment* (TRI) or the "breakeven" period, is similar in concept to the payback period (PP) discussed earlier, except that the break-even period takes discount rates into consideration. Again, the chief disadvantage of such a measurement is that investments of unequal lifetimes cannot be compared. However, this measurement of performance is often useful to financial planners and budget analysis.

◉ Example of Calculation

Management is considering a capital investment in its manufacturing process for energy conservation purposes which will cost $100,000 to design and install but will involve no new recurring costs. This project is expected to save an average of 27,500 MBtu of natural gas per year for the next 10 years. The cost of this fuel during the time period is initially $1 per MBtu and assumed to escalate 15% per year. Assuming that management feels that a 20% discount rate is appropriate, will this be a profitable investment:

Investment (INV) = $100,000
Annual Fuel Savings (AFS) = 27,500 MBtu/yr
Projected Fuel Price (PFP) = 2.335/MBtu

Net Annual Savings (S) = (AFS x PFP) - AOC

= (27,500 MBtu/yr x 2.335/MBtu) - 0
= $64,210 per year

A. First Level Measure of Performance

Payback period (no discounting)

$$PP = \frac{INV}{S} = \frac{\$100,000}{\$64,210/yr} = 1.6 \text{ year}$$

Return on Investment

$$DC = \frac{INV}{n} = \frac{\$100,000}{10 \text{ years}} = \$10,000 \text{ per year}$$

$$ROI - \frac{\%}{yr} = \frac{S-DC}{INV} \times 100\% = \frac{(\$64,210/yr - \$10,000/yr)}{\$100,000} \times 100\%$$

= 54.2% per year.

Using return on investment (ROI) as an approximation of the profitability of this project, we see that even after an allowance for depreciation this appears to be an attractive investment. Second level measurements of performance are needed, however, if we wish to incorporate the time value of money into the analysis.

B. Second Level Measures of Performance

Benefit/Cost Analysis: In order to formulate a benefit/cost ratio we must find the present value of future savings. This will result in a benefit/cost ratio (B/C) equal to:

$$BCR = \frac{PV}{INV} = \frac{\$219,237}{\$100,000} \text{ or } 1.15$$

Now it becomes apparent that this is a profitable investment even when the time value of money is considered.

Time to Recoup Investment (TRI) = 2.2 years. While this is longer than the payback without discounting, it provides a much better indication of the profitability of this investment because it includes the cost of foregone investment opportunities. If the proper discount rate has been used, any investment which is recouped in a period of less than its lifetime should be considered profitable.

(Reference: Energy Conservation Program Guide for Industry & Commerce, NBS Handbook 115).

Actual Auditing Techniques and Forms

Level II of the NECPA - 78 calls for the use of an Energy Audit Checklist to be performed by a certified auditor. The state of Oregon is responsible for the certification of Energy Auditors and has conducted special workshops to educate and certify both district personnel and engineering firm representatives as Energy Auditors. The Energy Audit Checklist procedure is really not very complicated and districts should be aware that to have an engineering firm perform the survey may easily cost $1,000 or more. If instead the district is willing and able to provide someone from their own staff for the training sessions and reimburse that person (such as a District Energy Coordinator) the district could save considerable money and benefit from having an

in-district expert on specific energy problems. The first phase of this program has called for a preliminary Energy Inventory and the person who performed that may be the most suitable for auditor certification and the completion of the Energy Audit.

The following quote from the introductory page of the Energy Audit Checklist explains basic procedures and recommendations:

> "After a basic understanding of the facility has been gained through completion of the Energy Inventory and from the preceding discussion of building systems, your team is ready to schedule a walking tour of the building. Outside areas as well as the main buildings are to be included in the tour which should be conducted during normal operating hours.
>
> The checklist which follows is organized according to building systems. Trouble spots are indicated by appropriate symptoms or conditions, each capable of being observed by individuals with non-technical backgrounds in energy management. (No elaborate equipment is required; however, it is recommended that, if available, a standard dry-bulb thermometer, a light meter and building plans be used to facilitate data collection.)
>
> Corresponding to each condition are appropriate operational and maintenance prodecures (O&M) and conservation measures (retrofit options) which can rectify the problem. The O&M options should be implemented, where possible, before considering the energy conservation measures. Keep a record of your progress by indicating the dates of implementation of O&M options, initials of 'implementors' and whether applicable. Energy measures should be checked if they are to be considered or if they do not apply.
>
> Remember: First priority should be given to the operational and maintenance options --- usually the most rapid means of reducing energy consumption. Operational and maintenance options include the rest of readjustment of existing systems to achieve increased efficiency and generally involve 'no-cost or low-cost' procedures. Only when all possible operational and maintenance options have been employed should the more capital intensive energy measures (retrofit and redesign options) be considered."

As stated in the foregoing introduction to the Energy Audit Checklist, the procedures are really quite simple and can be performed by someone without a specific engineering background. Included next is an actual copy of one of the 63 checklists.

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION

Exists	Doesn't Exist	
☐	☐	A-1 Thermostats on heating/cooling units are vulnerable to occupant adjustment.

SUGGESTED O & M OPTIONS:

	Date Completed	Initials	N.A.
Reset thermostats to correct settings.	☐	☐	☐
Install or replace locking screws to prevent tampering.	☐	☐	☐

SUGGESTED ENERGY MEASURES: (RETROFIT)

	To Be Considered	N.A.
Install tamper-proof locking covers on thermostats.	☐	☐
Install pre-set solid state electric thermostat if existing.	☐	☐
Relocate thermostats in return air ducts where they will be inaccessible to occupants.	☐	☐

Finally, once the audit has been concluded, a Condition Summary form is filled out by the auditor. Only this form and the application for assistance are actually submitted to the state for review and consideration. The copies of the audit are retained by the district for use in guiding the implementation of all desirable measures. The condition summary page included here is copied from the final pages of the Energy Audit Checklist:

C

CONDITION SUMMARY PAGE

ADMINISTRATION

☐ A-1 Thermostats on heating/cooling units are vulnerable to occupant adjustment.

☐ A-2 Thermostat settings have not been adjusted for change in seasons.

☐ A-3 Unoccupied or little used areas are heated or cooled unnecessarily.

☐ A-4 Off-hour activities are scheduled.

☐ A-5 Building temperatures are not adjusted for unoccupied periods.

☐ A-6 Heating/cooling equipment is operating in lobbies, corridors, vestibules and/or other public areas.

☐ A-7 Heating/cooling equipment is started before occupants arrive and/or is operating during last hour of occupancy.

☐ A-8 Use of equipment associated with laundry and custodial services coincides with heavy electrical demand periods.

☐ A-9 Blinds and curtains are not used to help insulate the building.

☐ A-10 No records of maintenance for motors and motor driven equipment are available.

☐ A-11 Control devices are not inspected on a regular basis.

☐ A-12 Conditioned air or heated water is discarded.

LIGHTING

☐ L-1 Incandescent lamps are used in offices, workrooms, hallways and gymnasiums.

☐L-2 In fixtures where flourescent lamps have been removed, the ballasts have not been disconnected.

☐L-3 When burned outflourescent lamps and/or ballasts have been replaced, more efficient lights have not been installed.

☐L-4 Lamps and fixtures are not clean.

☐L-5 Exterior lighting is used.

☐L-6 Lights are on in unoccupied areas.

☐L-7 Natural lighting is not optimized.

☐L-8 Two lamps have not been removed from four-lamp fixtures where possible

BUILDING ENVELOPE

☐B-1 Improper alignment and operation of windows and doors allows excessive infiltration.

☐B-2 Ceiling/roof insulation is inadequate or has been water damaged.

☐B-3 Weatherstripping and caulking around windows, doors, conduits, piping, exterior joints, or other areas of infiltration between conditioned and unconditioned spaces.

☐B-4 Excessive expanses of glass exist on exterior walls.

☐B-5 There is no insulation between conditioned and unconditioned spaces.

VENTILATION

☐V-1 An excessive quantity of outdoor air is used to ventilate the building.

☐V-2 Outdoor air intake dampers open when building is unoccupied.

☐V-3 Ventilation systems are not utilized for natural cooling capability.

☐V-4 Exhaust system operation is not programmed.

☐V-5 Return, outdoor air and exhaust dampers are not sequencing properly.

☐V-6 During heating season, temperature of air flow to space feels too cold.

☐V-7 Air flow to space feels unusually low or is inconsistent from one space to another.

C ENERGY INVENTORY

Knowing Your Building

This information is essential to your understanding of building energy demand, using the audit checklist, preparing a report of the energy audit* and to your development of a realistic energy management program.

The Energy Inventory organizes important data concerning your building of facility according to the following categories:

A. General Administrative Information
B. Occupancy Patterns/Operating Conditions/Activity Groups
C. Physical Characteristics
D. Annual Energy Consumption Summary
E. Energy Systems
   a. Lighting
   b. HVAC
   c. Heating & Cooling Sources
   d. Water
   e. Special Services
F. Solar and Renewable Resources
G. General Remarks

Much of this information may be required later by your state energy office in your application for technical assistance. Should technical questions arise concerning mechanical equipment in operation in your building, consult your engineer or the appropriate service company.

It is suggested that the different sections in the Energy Inventory be filled in by qualified personnel:

General Administrative Information, Occupancy Patterns/Operating Conditions/Activity Groups, and Annual Energy Consumption Summary might best be completed by the building administrative personnel.

Physical Characteristics and Energy Systems--Lighting, Water Usage might best be completed by maintenance personnel.

Energy Systems--Ventilation, and Heating and Cooling might best be completed by the building engineer. (In the absence of a building engineer the maintenance personnel should complete these sections).

The Section dealing with Special Services such as laundry and food preparation might best be completed by the special services personnel.

*Information elements marked with an asterisk (*) are not specifically required by federal rule-making but can be useful for energy management programs in individual institutions.

It is obvious that even if no assistance grants are received, completion of this checklist will aid any district in examining the energy use patterns and possibilities for savings that exist. The O&M and retrofit suggestions are concise and provide mechanisms for reducing energy use now.

ELIGIBILITY PREPARATION FOR THE NATIONAL ENERGY CONSERVATION POLICY ACT AND OTHER PROGRAMS ON THE HORIZON

Following are, again, the immediate steps necessary to be eligible for funding under NECPA:

LEVEL I - Preliminary Energy Audit needs to be prepared and sent to the Oregon Department of Energy.

LEVEL II - Completion and Certification of Energy Audit. (Full forms may be obtained from the Oregon Department of Energy and a copy is contained in the Appendix.)

LEVEL III - Completion of a District Energy Analysis. (This is to be completed by a registered engineer or engineer/architect team.)

Getting Prepared - Guides to Other Funding Sources

Besides state and federal offices of Energy and Education, other possibilities for funding exist. One program that can be used is a CETA proposal for weatherization of district buildings. It may be necessary for a district to commit some monies to supervisory personnel, although it is possible to even have these positions funded by CETA. Since supervisory position wages are low it might be difficult to procure expert supervision without district funds. CETA has shown good response to

weatherization programs. Several are now fully operational in Oregon as training positions for weatherization technicians. Another possibility for funding may be the newly formed Western S.U.N. (Western Solar Utilization Network) created by the Federal Department of Energy and 13 western states. Offices for Western SUN are in Portland, Oregon.

Be Prepared for Future Programs

Although it is impossible to predict with accuracy what future programs, regulations and grants may become available to help school districts cope with rising energy costs, several predictions can be made. Future programs created by federal legislation nearly always filter down through state operations. Changes in emphasis may occur at the state level. Keeping current with the directions of the State Departments of Energy and of Education is important. Information about future programs often is available long before the program goes into actual operation. Good contacts with state specialists should be established and maintained by every school district. We can predict that with increasing energy costs the federal government will respond with a variety of incentives for public buildings to become more energy efficient. School districts should plan now to commit funds for future matching costs. Districts should also be prepared to document efforts already made to reduce energy consumption. The creation of a Federal Department of Education also may mean special programs and grants. The district that prepares now will be in a better position to qualify for future assistance.

The demand for increased energy efficiency will persist. School districts will be faced with continually rising energy costs. Prudent school leaders and school boards cannot afford to postpone development of a district energy management plan.

APPENDIX A

PRELIMINARY ENERGY AUDIT

SCHOOLS
HOSPITALS
LOCAL GOVERNMENTS
PUBLIC CARE INSTITUTIONS

OREGON
DEPARTMENT
OF
ENERGY

MAY 1979

PRELIMINARY ENERGY AUDIT FOR SCHOOLS,

HOSPITALS, LOCAL GOVERNMENTS, AND PUBLIC CARE INSTITUTIONS

The Preliminary Energy Audit seeks to assemble general energy-related information about a single building or a group of related buildings (such as a college campus or a multi-building hospital). The requested information should, for the most part, be available in the business or administrative office. Some technical information is requested, but it is generally of the readily-available or easily-obtained variety.

It is quite possible that this form may not exactly suit your particular building or buildings. Please work within the limitations of the format to provide the requested information in as concise and appropriate a manner as possible. If some items are not applicable, so state. If you wish to include additional comments, please attach separate pages.

If additional Preliminary Energy Audit forms are needed, you can duplicate these forms or request additional forms from the Oregon Department of Energy (from Salem, telephone 378-5711; the toll-free telephone number from outside the Salem area is 1-800-452-7813).

The information you provide will help the Oregon Department of Energy do the best possible job of planning for this program. Thank you.

1. Name of School, Hospital, Local Government Building, or Public Care Institution:
   _____

2. Street Address: _____ City: _____

   County: _____, OREGON Zip: _____

3. Year of Initial Construction _____ Year of Last Major Modification or Addition: _____

4. Owner _____ (Check One) ☐ Public
   ☐ Private Non-Profit
   PUBLIC SCHOOLS ONLY: School District No.: _____ ☐ Indian Tribe

5. Building Use (Check appropriate box(es)):

School	Hospital	Local Government	Public Care
☐ Elementary	☐ General	☐ Office	☐ Nursing Home
☐ Secondary	☐ Mental	☐ Storage	☐ Other long-term care (specify)
☐ College/University	☐ Other (specify)	☐ Service	_____
☐ Community College	_____	☐ Library	☐ Rehabilitation Facility
☐ Vocational	_____	☐ Police Station	☐ Public Health Center
☐ ESD	_____ _____	☐ Fire Station	☐ Residential Child Care
☐ Other (specify)	_____ _____	☐ Other (specify)	
_____	_____ _____	_____	

6. Description of Building(s):
   - ☐ Single building
   - ☐ Major building with outbuildings
   - ☐ Cluster of buildings
   - ☐ Building complex with central heating plant

   Number of Buildings (that are heated and/or cooled): _____

7. Total Gross Square Feet: _____ sq. ft. (The sum of floor areas for all floors, including basements, in all buildings which are heated or cooled. Exclude the floor areas of spaces that are neither heated nor cooled. Do not include outdoor areas. Calculate floor areas using outside wall dimensions.)

8. Approximate Daily Hours of Building Use (check one box on each of the three day-of-week lines):

	Hours per Day					
	Not Used	1-4	5-8	9-12	13-16	17-24
Mondays thru Fridays	☐	☐	☐	☐	☐	☐
Saturdays	☐	☐	☐	☐	☐	☐
Sundays	☐	☐	☐	☐	☐	☐

9. Approximate Total Number of People in the Building(s) During Normal Periods of Occupancy: _____.

   Is/are the building(s) only partially occupied at certain times? Describe briefly _____

10. (FOR SCHOOLS ONLY) Are vacation periods of one week or more scheduled during the 1978-79 school year? If so, enter the number of weeks in the appropriate spaces to the rights.

Quarter	No. Weeks
☐ Summer	
☐ Fall	
☐ Winter	
☐ Spring	
TOTAL	weeks

11. Major Energy Using Systems - if more than one type of fuel or energy is used for a system, indicate by "P" (for Primary) or "S" (for Secondary) within the appropriate squares.

	Type of Fuel or Energy				
Description	Electric	Oil	Nat. Gas	Other (specify):	Type of Equipment (describe briefly; e.g., steam boiler)
Heating	☐	☐	☐	☐ _____	_____
Air Conditioning (if any)	☐	☐	☐	☐ _____	_____
Domestic Hot Water	☐	☐	☐	☐ _____	_____
Food Service (if any)	☐	☐	☐	☐ _____	_____
Laundry (if any)	☐	☐	☐	☐ _____	_____
Other major energy using systems, if any (specify)					
_____	☐	☐	☐	☐ _____	_____
_____	☐	☐	☐	☐ _____	_____
_____	☐	☐	☐	☐ _____	_____

Lighting: Approximate percentages:

incandescent	_____ %
other (fluorescent, mercury vapor, etc.)	_____ %
TOTAL	100 %

MONTHLY ENERGY DATA
for the 12-month period from January 1, 1978 to December 31, 1978

Amount	Electricity		Natural Gas[b.]		Fuel Oil[c.]		Other: _____[d.]		Other: _____[d.]	
	Amount (kwh)	Cost ($)	Amount (cu. ft.)	Cost ($)	Amount (gal.)	Cost ($)	Amount (_____)	Cost ($)	Amount (_____)	Cost ($)
January										
February										
March										
April										
May										
June										
July										
August										
September										
October										
November										
December										
TOTAL[a.]										

NOTES

a. For each type of energy, use these column totals for the "Amount" and "Annual Cost" entries for the "Fuel Use and Cost" table on the facing page.
b. The amount of natural gas (if any) must be stated in cubic feet. If your natural gas billings are in "therms," multiply therms by 97 to convert to cubic feet.
c. The amount of fuel oil (if any) must be stated in gallons. If your fuel oil billings are in "barrels", multiply barrels by 42 to convert to gallons.
d. If "Other" fuels are used, specify type of fuel and unit of measure.

12. Fuel Use and Cost (for the 12-month period from January 1, 1978, to December 31, 1978)

Type	Annual Energy Units: Amount			Factor (see note below)		Annual Btu		Annual Cost
Electricity	_____	Kwh	x	11,600	=	_____	$	_____
Natural Gas	_____	cu. ft.	x	1,030	=	_____	$	_____
Fuel Oil (#2, kerosene)	_____	gal.	x	138,690	=	_____	$	_____
Fuel Oil (#5, #6, Bunker C)	_____	gal.	x	149,690	=	_____	$	_____
Coal	_____	tons	x	24.5 million	=	_____	$	_____
Liquefied Petroleum Gas (LPG)	_____	gal.	x	95,475	=	_____	$	_____
Steam	_____	lbs.	x	1,390	=	_____	$	_____
Other (specify) _____	_____		x	_____	=	_____	$	_____
				TOTALS		_____ (12.a.)	$	_____ (12.b.)

Note: The "Factors" are prescribed by the Federal regulations, and must be used as shown to convert the listed energy types to consistent British Thermal Units (Btu's). Conversion factors for "Other" fuels may be taken from engineering reference manuals for any energy sources not listed.

13. Energy Indexes

$$\frac{\text{Total Annual Btu (Item 12.a)}}{\text{Total Gross Square Feet (gsf) (Item 7)}} = \frac{\text{Btu}}{\text{gsf per year}}$$

$$\frac{\text{Total Annual Energy Cost (Item 12.b)}}{\text{Total Gross Square Feet (gsf) (Item 7)}} = \frac{\$}{\text{gsf per year}}$$

14. Energy Related Activities

Person designated to monitor and evaluate energy use:

Name _____ Telephone _____

	Yes	No
Has an energy audit been performed?	☐	☐
Have detailed engineering studies been conducted?	☐	☐
Are energy management practices in force?	☐	☐

Briefly describe any energy conservation measures previously implemented:

Description	Year	Cost	Estimated Annual Energy Savings (if available)
_____	19__	$_____	_____ Btu
_____	19__	$_____	_____ Btu
_____	19__	$_____	_____ Btu

15. Solar and Renewable Resource Potential

If this Preliminary Energy Audit is for <u>one</u> building, provide the requested information for that building. If this Preliminary Energy Audit is for a complex of <u>more than one</u> building, provide the requested information for the one building that you feel is the <u>best single candidate</u> for a possible solar energy project.

Name of building: _____

Number of stories: _____ Gross Square Feet: _____

Nature of building location (check one):

☐ Urban
☐ Suburban
☐ Rural

Is there open land such as a field, yard, or parking lot, not heavily shaded, available in the immediate vicinity of the building?

- ☐ Yes
- ☐ No

Is more than half the building's roof area heavily shaded for more than about 4 hours per day?

- ☐ Yes
- ☐ No

Is more than half the building's south wall heavily shaded for more than about 4 hours per day?

- ☐ Yes
- ☐ No

General description of building's shape:

- ☐ Square
- ☐ Rectangular
- ☐ E-shaped
- ☐ H-shaped
- ☐ L-shaped
- ☐ Other (specify)

_____

Is the building's roof flat or pitched?

- ☐ Flat
- ☐ Pitched

If the roof is pitched, does it have a general southern orientation?

- ☐ Yes
- ☐ No

Are there existing obstructions on the roof, such as chimneys, mechanical equipment, or stairwells?

- ☐ None
- ☐ Minimal
- ☐ Significant

What is the predominant material, other than glass, of which the south-facing wall is constructed?

- ☐ Masonry
- ☐ Wood
- ☐ Metal
- ☐ Other (specify)

_____

What is the approximate percentage of glass in the south-facing wall?

- ☐ less than 25%
- ☐ 25 to 50%
- ☐ 50 to 75%
- ☐ more than 75%

Space-heating equipment:

Location	Type of Unit(s)
☐ Basement	☐ Single
☐ Ground Floor	☐ Multiple
☐ Intermediate Floor	☐ Combination
☐ Roof	
☐ Outside Building	

Domestic hot water heating equipment:

Location	Type of Unit(s)
☐ Basement	☐ Single
☐ Ground Floor	☐ Multiple
☐ Intermediate Floor	☐ Combination
☐ Roof	
☐ Outside Building	

The information on this form has been provided by:

Name: _____

Title: _____

Organization: _____

Address: _____

_____

Telephone: _____

Please keep a copy of this Preliminary Energy Audit for your files.

RB:kp
#2256A
5/02/79

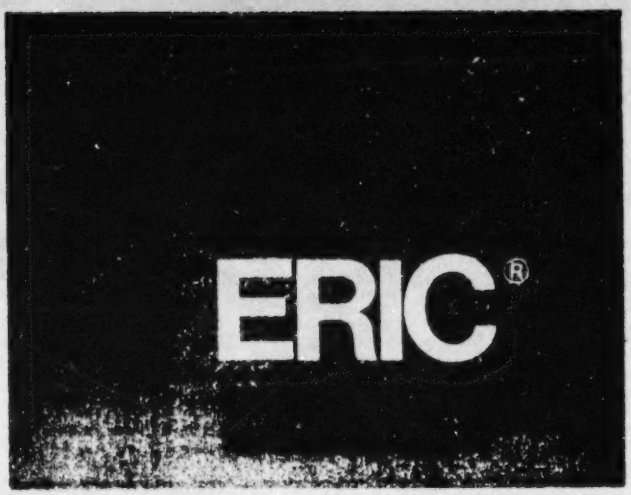
APPENDIX B

THE BEST OF ERIC

ON EDUCATIONAL MANAGEMENT

USED BY PERMISSION OF ERIC CLEARINGHOUSE ON EDUCATIONAL MANAGEMENT

Number 47, November 1979



The Best of ERIC presents annotations of ERIC literature on important topics in educational management.

The selections are intended to give educators easy access to the most significant and useful information available from ERIC. Because of space limitations, the items listed should be viewed as representative, rather than exhaustive, of literature meeting those criteria.

Materials were selected for inclusion from the ERIC catalogs *Resources in Education (RIE)* and *Current Index to Journals in Education (CIJE)*.

ERIC Clearinghouse on Educational Management

Energy Management

1 **American Association of School Administrators.** *Public Schools Energy Conservation Measures: Management Summaries.* Washington, D.C.: 1978. 20 pages. ED 164 339.

As part of the federally funded "Saving Schoolhouse Energy" project, ten representative elementary schools from across the nation underwent a "thorough and comprehensive engineering analysis" to determine areas of possible energy savings. Several "energy conserving opportunities" (ECOs) were identified at each site, and recommendations were made for actions considered cost-effective (initial investment recoverable within twelve years from the predicted energy savings).

The total projected costs of the recommendations at each site ranged from $1,000 to $80,000, with a mean expenditure of $25,000. The real surprise in this report, though, is the size of the predicted energy savings: "Preliminary projections suggest these expenditures will reduce energy consumption an average of 50 per cent across all ten sites."

The most frequent recommendations, and the ones with the quickest recovery rates, were to reduce outside air intake to minimum standards and to adjust various controls. Other suggestions included modifying the building envelope (increasing insulation and weather-stripping, decreasing glass surfaces), replacing incandescent lighting with fluorescent, modernizing and adjusting boilers and ventilation systems, and revising the occupied/unoccupied cycle.

The engineering analyses described here represent the first phase in the Saving Schoolhouse Energy project. Later phases include making the changes recommended in phase one, monitoring postmodification energy use, and disseminating the findings of the project. Brief descriptions of each school and the modifications suggested for each are contained in this report. Also included is an order form for ordering detailed reports of each school-site analysis.

2 **Askin, Ralph J.,** and others. *California School Energy Concepts, 1978.* Sacramento, California: Bureau of School Planning, California State Department of Education, 1978. 49 pages. ED 165 341.

Before the advent of mechanical temperature-control systems, buildings were necessarily designed with climate in mind. With technological advances and the availability of cheap energy, however, an arrogant disregard for nature became stylish. Now, with the energy crisis upon us, "architects are 'rediscovering' many of the techniques for climate control that have existed since the time of ancient Egypt but that were discarded or lowered in priority during the era of cheap energy." This publication discusses many of these "forgotten" techniques of building design, along with many new ideas for reducing energy consumption in new and existing school buildings.

Among the traditional variables that should be considered in building design are site selection (topography, prevailing winds, trees, other buildings), orientation, building shape, landscaping (deciduous trees for shade, evergreens for windbreaks), insulation, and color (dark roofs and walls absorb more heat). Other measures that can be taken to reduce energy consumption include the installation of solar energy systems, the use of double sets of external doors enclosing unheated vestibules, the reduction of electric usage during peak load times when rates are higher, and the installation of heat recovery systems.

Heat recovery involves redirecting "waste" heat to places where it can be used. Much heat, for example, is lost in the exhaust air. A "rotary heat wheel," which rotates slowly between the exhaust and incoming air streams, can reclaim up to 80 percent of the heat and pay for itself in a few years. Included are tables outlining recent "energy responsive" projects in schools, section drawings of some energy-efficient schools, and a fifty-entry bibliography.

3 **BRI Systems.** *Encouraging School Transportation Effective Energy Management (ESTEEM). Fuel Economy Management Handbook for Directors of Pupil Transportation; School District Administrators; Transportation Department Management.* Phoenix, Arizona: 1977. 161 pages. ED 165 317.

"Reductions in school bus maintenance and fuel costs of 40-60 percent or greater were successfully achieved" in many of the nation's school districts after they implemented energy-saving programs, states this federally financed publication. With an abundance of useful suggestions, this handbook shows how nearly every school district can cut costs in many areas of their transportation system.

In purchasing, for example, savings can be achieved by selecting the most suitable and energy-efficient equipment available. Radial tires, diesel engines, streamlined buses, and electronic ignition systems all save fuel. Fuel should be purchased by the truckload to obtain discounts, and parts should be ordered for a full year to obtain the best price. Also, advises the handbook, equipment should be matched with conditions: "purchase the smallest bus

with the smallest engine offering the most efficiency that fulfills transportation needs."

Driver attitude is another important factor in fuel economy. The driver training program should emphasize efficient driving methods, and driver motivation should be kept high. "Post weekly or monthly vehicle and driver fuel consumption lists," recommends the handbook, and attempt to create a spirit of friendly competition among drivers. Also, post charts comparing current fuel consumption with the district's consumption goals.

Bus idling time can be reduced by planning routes to make only right-hand turns, and by avoiding bus travel during peak traffic hours. Fewer buses can be used if staggered dismissal times are eliminated, and if bicycling and walking are encouraged.

Also discussed in this wide-ranging handbook are public relations programs for energy conservation programs, student participation programs, and guidelines for monitoring energy management activities.

---

4 **British Columbia Department of Education.** *Energy Conservation for Schools. 1978 Edition. Report Number 00654-78-09.* Victoria, British Columbia: 1978. 29 pages. ED 166 047.

By following the energy conservation plan outlined in this booklet, most school districts can reduce energy consumption by 20 percent. This figure is "not an exaggeration," the authors stress, but "can be attained and at a cost that would pay for itself in one to two years."

The first step is to appoint an "Energy Conservation Manager" to run the program. The energy manager could be an interested and motivated teacher, school board member, administrator, maintenance person, or even someone from outside the school system.

The energy manager should calculate the total energy consumed by each school in the district, using the three energy consumption record sheets provided in the booklet. One is for electricity consumption, another for oil and gas consumption, and the third for calculating both total energy consumption and the school's rating on an energy-use index (which corrects for differences in outside temperature).

With the information from the energy consumption record sheets, each school's energy use can be compared with the "energy consumption targets" provided in the booklet. These target figures reflect the "unit area energy consumption levels which should be attainable in a large number of schools without major capital expenditures."

The final step in this conservation program is to conduct an energy survey of the district's schools to identify areas where significant energy savings can be made. Experienced technical personnel—either from the district or from a consulting engineering firm—should conduct the survey and report findings and recommendations to the school board. Included is a list of conservation areas that the survey should cover.

---

5 **Burr, Donald F.** "Creating Energy-Efficient Buildings." Paper presented at the American Association of School Administrators annual meeting, Atlanta, February 1978. 14 pages. ED 165 270.

Contrary to the popular impression, says Burr, the technology for making buildings energy-conservative is *not* twenty or thirty years in the future. Rather, that technology is available *now* and is probably the most developed area of energy conservation today.

One essential ingredient of all new building designs, says Burr, should be an energy (heat) storage system. Heat storage systems can use water, rock, or eutectic salts as their storage medium. Electrical energy can be purchased at night, when rates are much cheaper, and used to heat the rock, water, or salt for the next day's heating needs.

A water storage system is attractive because it can be linked directly to a hydronic (water-based) heating/cooling system in the building. Such a system can also be connected directly with roof-mounted solar energy collectors.

In most high schools, about 25 percent of all energy consumed is used to heat domestic hot water, primarily for showers. But about 80 percent of this heat can be reclaimed by collecting the waste water in an insulated storage tank and passing cold water through closed pipes in the tank.

Another "water idea" discussed by Burr is the use of an "on-site well with heat pump system." If ground water is available, it can often be circulated through a heat pump to help heat the building in winter and cool it in summer. Two wells are needed, says Burr, one for pumping water up, and the other for pumping the heated or cooled water back down (to minimize impact on the water table).

---

6 **California State Department of Education.** *Energy and Water: Conservation Suggestions for California's Elementary and Secondary Schools.* Sacramento, California: 1977. 27 pages. ED 166 031.

The two keys to increasing energy conservation as outlined in this booklet are wise facility and equipment management and an energy education program.

Energy education should be designed to help students and teachers "develop the skills, knowledge, and attitudes they need to

HOW TO ORDER COPIES OF ITEMS REVIEWED

DO NOT ORDER FROM THE CLEARINGHOUSE

The numbers below correspond with the numbers assigned each entry in the text. Following each number is the ordering information for that particular item. Instructions for ordering materials from UMI, EDRS, or the publisher follow the list.

1. EDRS. Specify ED 164 339. MF $0.83 PC not available.
2. Publication Sales, California State Dep't. of Education, P.O. Box 271, Sacramento, CA 95802. $0.85.
3. Voluntary Truck and Bus Fuel Economy Program, U.S. Dep't.of Energy, Washington, D.C. 20461. Free.
4. EDRS. Specify ED 166 047. MF $0.83 PC $3.32.
5. EDRS. Specify ED 165 270. MF $0.83 PC $1.82.
6. California State Dep't. of Education, 721 Capitol Mall, Sacramento, CA 95814. Free.
7. Council of Educational Facility Planners, int'l., 29 West Woodruff Ave., Columbus, OH 43210. $27.50 nonmembers, $25.00 CEFP members.
8. National Technical Information Service (NTIS), U.S. Dep't. of Commerce, 5285 Port Royal Rd., Springfield, VA 22161. MF $3.00, PC $6.00.
9. UMI. Specify EJ 164 144. $6.00.
10. EDRS. Specify ED 164 297. MF $0.83 PC not available.
11. UMI. Specify EJ 173 511. $4.00.
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use energy resources wisely." An energy education program, however, should not be simply an "add-on" to the curriculum. Instead, it should be incorporated into the instruction of many subjects, including social studies, science, home economics, and mathematics. To help in implementing such a program, several sources of developed curriculum material and "teacher kits" are listed.

Since each school building is unique in both design and environmental setting, each school must be looked at individually to detect potential areas for energy savings. There are some steps, however, that all schools can take to increase their energy efficiencies. For example, roofs and exterior walls that are painted with a light, highly reflective color will reduce heat gain from the sun, as will shade trees around the building. Exterior glass areas can be reduced to the minimum necessary for "visual relief" and replaced with insulated walls. And incandescent lights can be replaced with fluorescent or other high-efficiency fixtures.

7 **Council of Educational Facility Planners, International.** *Energy Sourcebook for Educational Facilities: An Authoritative and Comprehensive Sourcebook for the Design and Management of Energy Efficient Educational Facilities.* Columbus, Ohio: 1977. 275 pages. ED 147 996.

About one-third of all energy used in the United States is consumed in operating buildings, and educational buildings are the largest group of institutional buildings. Thus, "in schools alone, the potential for saving our finite resources is immense," states this comprehensive publication.

An initial unit discusses the development of an energy management plan for local school districts. An "Energy Management Committee" should first be formed to fulfill policy-making responsibilities for the program. Next, an "Energy Conservation Team" should be appointed and should include building principals; teacher, parent, and student representatives; maintenance and transportation supervisors; and outside energy consultants. The team "should have operational authority over all aspects of energy management" and should be directly responsible to the policy committee. After appropriate inservice training, the team should analyze school energy use and then determine appropriate goals and activities.

The next two units discuss methods of collecting energy data and auditing energy use in the district. Extensive checklists, energy data forms, and illustrative graphs and charts are provided. Three auditing methods are presented: the "mini-audit," consisting of a one- to two-hour inspection by energy specialists; the "maxi-audit," a comprehensive examination of energy-use patterns by an engineering consultant; and the Public Schools Energy Conservation Service (PSECS) audit method, which uses a computer program to simulate energy-use patterns in school buildings.

Other units cover detailed conservation measures that schools can take, contracting for outside professional services, case studies in energy conservation in school districts, public relations programs, cost-benefit analyses for conservation programs, one state's energy conservation plan, and the energy policy of the CEFP/I.

8 **Department of Energy.** *Energy Audit Workbook for Schools.* Washington, D.C.: Office of State and Local Programs and Office of State Grant Programs. 1978. 88 pages. ED 164 284.

"In a typical school," states this U.S. Department of Energy publication, "it is possible to save as much as 15% of utility costs through common sense actions without any appreciable capital expenditure." With a wealth of examples, checklists, and suggestions, the booklet shows how these savings can be achieved, as well as how *more* money and energy can be saved after wise investment in energy-efficient facilities and equipment.

The first chapter is a long checklist of simple procedural changes that can be implemented for little or no cost. Suggestions include the removal of unnecessary lights, the reduction of the hot water temperature to 110-120° F, and the judicious control of building temperature. The 144 practical suggestions are conveniently organized under important energy subheads, such as space heating, boiler use, air conditioning, ventilation, lighting, and kitchens.

The second chapter, which makes up the bulk of this workbook, outlines detailed step-by-step procedures for both analyzing energy use and computing the potential savings of particular energy-saving measures. Instructions are provided for filling out a removable "Energy Management Form" using electric and fuel bills as well as weather information.

Nine specific conservation "problems" are presented with a fill-in-the-blanks format. An accompanying example illustrates the computations.

9 **Downey, Gregg W.** "Some Sunshine for Your Fiscal Life: Solar Energy Schools May Not Be As Far Off or As Blue Sky As We've Thought." *American School Board Journal* 164, 8 (August 1977), pp. 56-60. EJ 164 144.

"Most schools are naturally suited for the installation of solar equipment," states Downey, because they are generally well constructed, have flat roofs suitable for solar collectors, and have their peak energy demands during daylight hours—thus lessening energy storage requirements. Already, many schools across the country are using solar energy for water heating, space heating, and space cooling.

One solar energy firm estimates that 15 to 30 square feet of collectors are needed for each 100 square feet of building floor space. And cost quotes, says Downey, range from $6 to $20 per square foot, including installation. Thus, solar installation is fairly expensive; however, the operating costs for solar are much lower than for fuel-fired systems, so investment costs can be recouped after a few years.

For example, the school board of Florida (New York) commissioned a feasibility study to determine ways to cut down energy costs in an aging school building serving about four hundred students. The report suggested retrofitting the building to decrease heat loss and installing a solar heating system for a total cost of $80,000. With a projected fuel savings of 35 percent per year, the investment could be recouped by 1986, said the report, and even sooner if fuel prices continue to rise.

10 **Kerns, Marilyn.** *Energy Conservation: An Examination of Energy Conservation Mechanisms As They Relate to School Districts in Region XI.* St. Paul: Educational Cooperative Services Unit, University of Minnesota, 1977. 68 pages. ED 164 297.

The first step a district can take to save energy is to develop a districtwide energy conservation plan. To help in this process, Kerns outlines two recently developed energy management plans: the Total Educational Energy Management (TEEM) approach, developed by the Colorado Department of Education; and the program developed by the Council of Educational Facility Planners, International (CEFP/I).

In both approaches, the working unit of the plan is an energy conservation committee, whose membership should include most or all of the following: district energy manager; superintendent; building principals; maintenance and transportation supervisors; business manager; energy consultants; utility company representatives; and community, teacher, and student representatives. In the TEEM model, the energy committee sets objectives, determines strategies and energy-audit methods, and arranges consultations with outside experts. Then building-level task forces are developed to implement the plans.

In the CEFP/I model, the programs and activities are both planned and implemented by the committee. The task committee reports directly to an energy policy committee, composed of board members, appropriate central office administrators, and energy experts.

The first action taken by an energy conservation committee might be to conduct an energy audit of the district's schools. She describes the same three auditing methods mentioned in CEFP/I's Energy Sourcebook. Also included are extensive checklists of energy conservation measures that schools can take.

11 **Nanni, Robert.** "Plugging the Energy Drain." *School Business Affairs,* 44, 2 (February 1978), pp. 33-34. EJ 173 511.

Using a small computer system, two high schools in Illinois have considerably reduced their power consumption, says Nanni. The computer is responsible for shutting off and on the thirty-eight air-handling units in the two schools, which vary considerably in horsepower and areas served.

"The computer-controlled on/off cycle intervals vary according to the time of day, the day of the week, and the season of the year," says the author. During school hours, the computer turns each fan off for six minutes of each half hour. After 4 P.M., the fans are turned off for fifteen minutes of each half hour. Between 9 P.M. and 5 A.M., the fans remain off.

Every half hour, the computer provides a print-out showing which air units are on, as well as the following electrical-usage information: power consumption totals, kilowatt-hour usage, the peak demand limit, and "the plus or minus percentage of actual consumption versus demand limit." When electrical usage approaches the utility's demand limit (where excessive demand-cost penalties are incurred), the computer compensates by shutting down fans for longer periods of time.

Since the computer control system is "open-ended," the district is considering expanding its use to other power management areas, such as controlling the mercury vapor lamps in the parking lots and monitoring the school bus gasoline pumps.

12 **Tiedeman, Thomas V.** *An Energy Conservation Retrofit Process for Existing Public and Institutional Facilities.* Washington, D.C.: Public Technology, Inc., 1977. 127 pages. ED 161 763.

Can modifying existing buildings really result in substantial energy savings? According to Federal Energy Administration (FEA) estimates, "a building owner may expect to save 10%-20% in energy use without any initial cost, another 10% with minimal first costs, and 10%-20% more with an investment which can be paid back by savings in three to ten years."

In this publication, Tiedeman concentrates on those modifications that require some capital expenditure. Even if the funds available for retrofit are small, he emphasizes, viable conservation options are likely to exist.

The first phase in the retrofitting process is to determine the most energy inefficient facilities by studying past and current energy consumption patterns. Tiedeman presents three methods for conducting such a study, ranging from a "rough estimate" method to the sophisticated component-by-component method developed by the FEA.

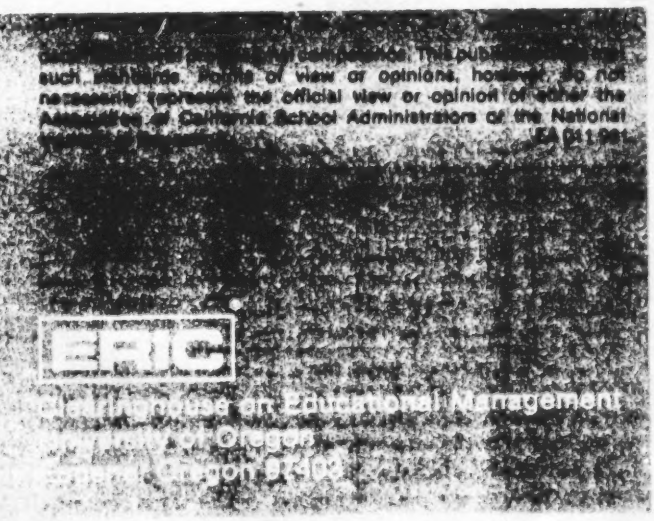
When the facilities most appropriate for retrofitting have been identified, each should undergo a "detailed engineering and architectural study of potential energy conservation modifications." Detailed instructions for choosing consulting firms and evaluating their qualifications are included.

Once the retrofitting has been completed, it is important to monitor the results of the project to determine whether savings have actually been achieved. An added benefit of monitoring is that it becomes easier to identify whether retrofitting should be initiated on similar buildings in the future.

The Educational Resources Information Center (ERIC) is a national information system operated by the National Institute of Education. ERIC serves educators by disseminating research results and other resource information that can be used in developing more effective educational programs. The ERIC Clearinghouse on Educational Management, one of several such units, was established at the University of Oregon. The Clearinghouse and its companion units process research reports and journal articles for announcement in ERIC publications such as this bulletins.

Besides processing documents and journal articles, the Clearinghouse prepares bibliographies, literature reviews, monographs, and other interpretive research studies on topics in its educational area.

This publication was prepared pursuant to a contract with the National Institute of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their judgment in professional and technical matters. Prior to publication, the manuscript was submitted to the Association of California School Administrators for critical review and


such attitude. Points of view or opinions, however, do not
necessarily represent the official view or opinion of either the
Associates of California School Administrators or the National
ERIC
Clearinghouse on Educational Management
University of Oregon

APPENDIX C

OREGON ENERGY AUDITOR TRAINING
EXCERPTS

A. GENERAL ADMINISTRATIVE INFORMATION

1-2. Indicate if single building or complex, enter the name, check the appropriate ownership, type and category. If other applies, enter a 1 or 2 word description (for example, a hospital which is neither a general hospital nor a TB hospital would check "other" and add "obstetrics and gynecology" or "eye, ear nose and throat," "orthopedic," "chronic disease," or other appropriate brief description.

3-4. Provide building address (do not use P.O. Box number--enter street address) and phone number. Note year constructed and date of last major addition or modification.

5-6. Record names and telephone numbers of building manager, building operator; record names of mechanical and electrical engineers. Record names and telephone numbers of person responsible for the building.

7. Has an energy management coordinator been designated?

8. Indicate whether major changes are anticipated in the facility proper or in its function for the next fifteen years; e.g., new construction, rehabilitation or demolition.

9. Indicate whether any other energy audit work has been completed or is currently underway.

10. Describe any conservation measures which have been implemented or are being considered and expected cost and energy savings expressed as an annual percentage reduction in the type of fuel affected. Attach additional page if necessary.

11. Describe any previous architectural/engineering studies.

12. Provide the names of the original architects and engineers of the building.

---

1. Name of Building or Complex: _____
Owner: _____
Public _____ Private _____
Non-Profit _____ Indian Tribe _____

2. Building Type and Category:

School	Hospital	Local Gov't	Public Care
___Elementary	___General	___Office	___Nursing Home
___Secondary	___Tuberculosis	___Storage	___Long-term Care
___Junior College	___Psychiatric	___Library	___Rehab. Center
___College or Univ.	___Other, Specify	___Services	___Orphanage
___Vocational	_____	___Police Station	___Public Health Ctr.
		___Fire Station	___Residential Child
___Other, Specify		___Other, Specify	Care
_____		_____	___Other, Specify
			_____

3. Building Address: _____ City _____
State _____ Zip _____ Telephone Number _____
4. Year constructed: _____ Year of last major addition or modification: _____
5. Building Manager: _____ Telephone Number _____
Building Operator: _____ Telephone Number _____
Person responsible for building: _____
Telephone Number: _____
*6. Mechanical Engineer: _____ Electrical Engineer: _____
7. Energy Management Coordinator designated: Yes No
8. Anticipated building modifications: _____
_____
9. Previous energy audit work completed: Yes No Specify, _____
_____
10. Conservation Measures (retrofit) already implemented or under consideration:
Yes No Specify project, cost and expected energy savings: _____
_____
_____
_____
11. Previous architectural/engineering studies: Yes No Specify: _____
_____
*12. Original Architects: _____
Original Engineers: _____

*Optional

B. OCCUPANCY PATTERNS/OPERATING CONDITIONS/CLIMATE INFORMATION/ACTIVITY GROUPS

1. Complete occupancy schedule. If the institution operates on a seasonal schedule, or has other periods of at least a week's duration when the building is only partially occupied, the number of weeks partial use by calendar quarter should be entered, along with the approximate percentage of total gross square feet in use during such periods.
2. Provide summer/winter operating conditions: average indoor temperature, normal indoor relative humidity, outside design temperature, average seasonal relative humidity.
3. Note U.S. heating and cooling zone in which building is located and climate information unique to your location. Refer to heating and cooling degree data.
4. List the kinds of activities housed within the building.

1.

Day(s)	Time Period	Average Occupancy	or % gsf Occupied	No. of Hours	Weeks/Year
Mon-Fri	day				
	evening				
	night				
Saturday	day				
	evening				
	night				
Sunday	day				
	evening				
	night				

Quarterly Partial Usage:

Quarter	Weeks	%gsf
1st		
2nd		
3rd		
4th		

*2. Operating Conditions:

	Summer	Winter
Average Indoor Temperature	____ °F	____ °F
Indoor Relative Humidity	____ %	____ %
Outside Design Temperature	____ °F	____ °F
Outside Relative Humidity	____ %	____ %

3. Building Location:

U.S. Heating Zone #_____ U.S. Cooling Zone #_____

Annual Heating Degree Days_____ Annual Cooling Degree Days_____

*4. List Facility activities (e.g., radiology, school administration, mayor's office and staff, etc.) and approximate area and time devoted to each.

a._____Area_____SqFt time worked_____Hrs/Day

b._____Area_____SqFt time worked_____Hrs/Day

c._____Area_____SqFt time worked_____Hrs/Day

d._____Area_____SqFt time worked_____Hrs/Day

e._____Area_____SqFt time worked_____Hrs/Day

(If more space is needed, attach a separate sheet.)

*Optional

C. PHYSICAL CHARACTERISTICS

1. To calculate gross square feet (gsf) multiply the outside dimensions or measure from the centerline of common walls and multiply by the number of floors. If the building has wings, or the number of floors varies in one part from another, divide the building into sections, calculate the area of each section, and total. (Deduct from the total area any parking garages or other areas which are neither heated nor cooled.) To obtain building volume, multiply average ceiling height times gross floor area.
2. Total the exterior glass area (excluding skylights), noting whether glass is single or double pane.
3. Total the exterior wall surface area (excluding skylights), noting predominant wall material. Indicate approximate overal thermal transmittance (U_o) for roof structure by multiplying area times U-value.

5-6. Note type and thickness of insulation material in roof, walls and floors.

7. Sketch position of facility on site with North arrow .
8. Briefly describe general building conditions.

---

1. Gross Floor Area: _____ SqFt X Gross Ceiling Height _____ Ft=Volume _____ CuFt

*2. Total Exterior Glass
Area: _____ SqFt Single Panes _____ SqFt
Double Panes _____ SqFt

	North Side	South Side	East Side	West Side
Total Area	_____ SqFt	_____ SqFt	_____ SqFt	_____ SqFt
Single Pane	_____ SqFt	_____ SqFt	_____ SqFt	_____ SqFt
Double Pane	_____ SqFt	_____ SqFt	_____ SqFt	_____ SqFt

*3. Total Exterior Wall
Area: _____ SqFt Material: Masonry _____ Wood _____ Other _____
U_o: _____ BRU Hr/F° Concrete _____ Stucco _____

*4. Total Roof
Area _____ SqFt Condition: Good _____ Fair _____ Poor _____

U_o: _____ BTU Hr/F°

*5. Insulation Type: Roof _____ Wall _____ Floor _____

*6. Insulation Thickness: Roof _____ Wall _____ Floor _____

*7. What is orientation of building on site? (Draw sketch with North arrow.)

8. Description of general building conditions:

_____

_____

_____

_____

_____

*Optional

D. ANNUAL ENERGY CONSUMPTION SUMMARY

1. Complete fuel use summary for base year (or last 12 months if no base year has been established), using utility records and blank forms provided in Section 3. (If no past records have been kept, call your utility.) Multiply by the conversion factors (as required by the Federal Register, Section 450, 42(11), April 2, 1979) and enter the results in Column D as annual BTU consumption. Transfer annual cost for each fuel from the appropriate Energy Data Form in Section 3, to Column E. (Attach copies of the Energy Data Forms from Section 3, to this page.) Compute consumption in BTU's per gross square foot per year by dividing the total of the entries in Column D by gsf. Compute energy dollars per gross square foot per year by dividing the total of the entries in Column E by gsf. (Obtain gross floor area from previous chart and energy costs from Energy Data Forms.)
2. Based on your past year's utility bills, complete peak electrical demand data. For buildings or complexes over 200,00 gsf or if the electric rate contains a demand charge, determine if demand is recorded. Note times at which typical peaks occur during daily operation. Also note whether demand fluctuates on a seasonal basis indicating month in which the highest demand occurs.
3. If data is available, indicate the fuel used by each of the major energy using systems listed and the annual consumption of each. For #5 "special", indicate special purpose facilities (e.g., food service, laundry) which use significant amounts of energy, fuel type used and annual usage.

A	B	C	D	E	F	G
Fuel	Previous 12 Month Totals	Conversion Factor =	BTU's Consumed	Annual Cost	BTU's/Gross SqFt/Year	$/Gross SqFt/Year
1. Electricity	KWH x	11,600 =				
2. Natural Gas	CCF x	103,000 =				
3. #2 Oil	gallons x	138,690 =				
4. #6 Oil	gallons x	149,690 =				
5. Steam	pounds x	1,390 =				
6. Coal	tons x	24,500,000=				
7. Propane	gallons x	95,475=				
8. Other, specify [3]	x	=				
9. Totals						

2. Peak Electrical demand:

   Annual: _____ KW
   Month: _____

3. Fuel Use by Major Energy-Using Systems:

System	Fuel Type	Annual Use
Heating		
Cooling		
Hot Water		
Lighting		
Special, specify		

1 #2 Oil should include other distillate fuel oils.
2 #6 Oil should include other residual fuel oils.
3 Use a standard engineering reference manual or factors provided by the State for other fuels.

*Optional

E. ENERGY SYSTEMS

a. Lighting

1-2. For each lighting type, fluorescent and incandescent, note the percentage of gross square feet of the building illuminated. Include an estimate of average usage in hours per week and hours per year.

3. Determine the total wattage presently used to illuminate the building's interior and divide by the gross floor area to compute an average lighting level in watts per square foot.

4. Note total interior and exterior loads in kilowatts by adding the wattages of all lamps (separately for each) and dividing by 1,000.

5. Note any unusual lighting applications.

---

1. Fluorescent:

   Percentage of Gross SqFt:_____% Usage:_____Hr/Wk_____Hr/Yr

2. Incandescent:

   Percentage of Gross SqFt:_____% Usage:_____Hr/Wk_____Hr/Yr

*3. Average Interior Lighting Level: _____Watts/SqFt

*4. Total Interior Lighting Load: _____KW

*5. Unusual Lighting Applications:

_____

_____

_____

_____

*Optional

GLOSSARY OF TERMS

ACTIVE SOLAR SYSTEM: A solar heating or cooling system that requires external mechanical power to move the collected heat.

AIR CONDITIONING: The process of treating air to meet the requirements of the conditioned space by controlling simultaneously its temperature, humidity, cleanliness and distribution.

ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers.

ASHRAE CYCLE II: A cycle of control admitting a minimum amount of outdoor air during the heating and ventilating stage. This percentage is gradually increased to 100%, if needed, during the ventilation cooling stage.

BRITISH THERMAL UNIT (BTU): A heat unit equal to the amount of heat required to raise one pound of water one degree Fahrenheit.

BTUH: British Thermal Units per hour.

CFM: Cubic feet per minute.

CHILLERS: A refrigeration machine using mechanical energy input to drive a centrifugal compressor to generate chilled water.

COEFFICIENT OF HEAT TRANSMISSION: Also called "U-Value," a coefficient expressing the thermal conductance of a composite structure, measured in $BTU/ft^2/hr/F°$. It indicates how much heat a structure will conduct.

COLLECTOR: Any of a wide variety of devices (flat-plate, concentrating, vacuum tube, greenhouse, etc.) used to collect solar heat and convert it to heat.

COP (Coefficient of Performance): The ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating plant, under designated operating conditions.

CONDUCTION LOSSES: Heat lost by heat flow through substances. Transfer of heat energy by the motion of adjacent atoms and molecules.

CONVECTION LOSSES: Heat lost or transferred from one location to another by the motion of fluids (including air) that carry the heat.

CONTROL: Any device used to vary the volume of air passing through an air outlet, inlet or duct.

CONVECTOR: A space heating device that operates with gravity circulated air and has a heating element with a large surface area. The heating unit may use steam, hot water, or electric energy.

DAMPER: A device used to vary the volume of air passing through an air outlet, inlet or duct.

DEGREE DAY HEATING: A unit based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 65°F (18°C) there exists as many Degree Days as there are Fahrenheit (Celsius) degree difference in temperature between the mean temperature for the day and 65°F (18°C).

DEW-POINT TEMPERATURE: A measure of humidity in relation to temperature. Also called a wet-bulb temperature.

DIRECT SOLAR METHODS: Techniques of solar heating in which sunlight enters a structure through windows and is absorbed by the inside of the structure.

DOUBLE GLAZING: Use of two panes of glass or other light transparent materials to provide increased insulating values due to the air space.

DRY-BULB TEMPERATURE: Temperature as measured by an ordinary thermometer

ECONOMIZER CYCLE: A method of operating a ventilation system to reduce refrigeration load. Whenever the outdoor air conditions are more favorable (lower heat content) than return air conditions, outdoor air quantity is increased.

EXHAUST AIR: Air removed from a space and not reused.

FAN COIL UNIT: A single-zoned air handling unit consisting of a motor, fan filter, and coils which may be used before heating, for cooling or both.

FINNED PIPE: A convector heating device fabricated from metallic tubing with metallic fins bonded to the tube. The unit operates with gravity circulated room air and may use steam or hot water.

HEAT LOSS: The sum cooling effect of the building structure when the outdoor temperature is lower than the desired indoor temperature. It represents the amount of heat that must be provided to a space to maintain indoor comfort conditions.

HEAT PUMP: A refrigeration machine possessing the capability of reversing the flow so that its output can be either heating or cooling.

HVAC: Heating, ventilating and air conditioning.

INFILTRATION: The process by which outdoor air leaks into a building by natural forces through cracks around doors and windows, etc.

INSOLATION: The total amount of solar radiation (direct, diffused and reflected) falling upon a surface exposed to the sky.

INSULATION: A material with high resistance (or R-Value) used to retard heat flow losses.

LIFE-CYCLE COSTING: An estimating method in which the long-term costs such as energy consumption, maintenance, and repair can be included in the comparison of several system alternatives. May include adjustments for inflating and increasing costs.

MHB: British Thermal Unit per hour (thousands).

MAKE-UP: Air taken from outside the building in order to replace exhausted air.

MANUAL: Capable of being operated by personal intervention.

MULTI-ZONE UNIT: A fan-coil system which serves a relatively small number of zones from a single, central air handling unit. Different zone requirements are met by mixing cold and warm air through zone dampers at the central air handler in response to zone thermostats. The mixed, conditioned air is distributed throughout the building by a system of single-zone ducts.

OPTIMIZATION CYCLE: A method of reducing an HVAC system's energy consumption. The heating air temperature is lowered to the lowest possible satisfactory setting (and the cooling air temperature is increased to the highest possible satisfactory setting) needed to supply the zone of greatest heating (or cooling) demand.

OUTSIDE AIR (OSA): Air taken from the outdoors and therefore not previously circulated through the system.

PASSIVE SOLAR SYSTEM: A solar heating or cooling system that uses no external mechancial power to move the collected solar heat.

R-Value: The resistance to heat flow. The reciprocal of thermal conductance, U-value.

RADIATION LOSSES: The flow of energy across open space via electro-magnetic waves such as visable light or infra-red radiation that loses heat in the flow from warmer to cooler surfaces or spaces.

RADIATOR: A cast iron space heating and radiation device whose primary means of heat transfer is by convection. The radiator may use steam or hot water.

REFRIGERANT: A liquid such as freon that is used in cooling devices to absorb heat from surrounding air or liquids as it evaporates in a system.

RESET: Adjustment of the set point of a control instrument to a higher or lower value automatically or manually to conserve energy.

RESISTANCE: Also designated as "R-value," the tendency of a material to retard the loss of heat. An inverse of the "U-value" of a material, so a high "R-value would mean a low "U-value."

RETROFITTING: The application of solar heating and cooling or added insulation or system modification devices to improve thermal efficiency.

RETURN AIR: Air removed from a space and recirculated.

SIMPLE COSTING: An estimating method in which the payback period of a system is figured by only estimating capital costs against current consumption costs, does not include adjustments for repair, maintenance or price increases.

SUPPLY AIR: Air delivered to each or any space in the system, or the total delivered to all spaces in the system, which is used for ventilation, heating, cooling, humidification, dehumidification, distribution, etc.

THERMOSTAT: An instrument which measures changes in temperature and controls device(s) for maintaining a desired temperature.

U-VALUE: A coefficient expressing the thermal conductance of a composite structure in $Btu/ft^2/hr/F°$ difference.

UNIT HEATER: A space heating device consisting of a motor, fan, heating element and an enclosure. The unit is usually designed to heat 100% return or recirculated air. The heating element may be gas or oil fired, electric, or use steam or hot water.

UNIT VENTILATOR, CABINET: A packaged assembly consisting of a motor, fan, heating element or coils, filters, inlet and outlet grilles, all encased in a cabinet. The unit is designed to provide a fixed amount of outside air up to 100% of the rated capacity.

VENTILATION AIR: That portion of supply air which comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

ZONE: A space or group of spaces within a building with heating and/or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

LOCATING MORE INFORMATION

1. Clearinghouses, agencies, contacts and more sources for information

State and Local Help

Oregon Department of Education
700 Pringle Parkway S.E.
Salem, OR 97310

Contact Persons: Al Davidson 378-8429
Bill Wilmot 378-8112
Jewel Manspeaker 378-8550

Help Available: Grant application forms, and assistance in filling out forms for the Energy Conservation Grant Program (For Energy Education: Claudia McDuffie)

Oregon Department of Energy
111 Labor and Industries Building
Salem, Oregon 97310

Contact Persons: Depends on assistance needed, contact the Department and tell them what you need.

Help Available: Information on grants, conservation, solar energy, energy education projects, etc.

Other Government Agencies
Contact: City or County Energy Specialists for local information
Also, local and county CETA programs for manpower

Public and Private Utilities
Contact local energy suppliers for information on conservation, films, speakers and special energy survey programs. Below we list a few of the major sources of energy information in Oregon:

Pacific Power and Light (503) 243-4345
920 S.W. 6th
Portland, OR 97204 (or contact local office)

Help Available: Information on conservation and all forms of energy publications, speakers, films

Portland General Electric Company (503) 226-8456
121 S.W. Salmon St.
Portland, OR 97204

Help Available: Similar to PP&L

State and Local Help, (cont.)

Eugene Water and Electric Board (503) 484-1125
500 East 4th Avenue
Eugene, OR 97440

Help Available: A variety of conservation programs, energy audits and a conservation center for information

Northwest Natural Gas (or local supplier)
123 N.W. Flanders
Portland, OR 97209

Help Available: Ad hoc basis speakers, information on conservation and systems efficiency

Additional Sources:

Oregon State University
University of Oregon/ Solar Center
Oregon Institute of Technology
Local Community Colleges

Help Available: Training programs in energy subjects
Experts in various energy fields

Federal/National Help

Bonneville Power Administration (503) 234-3361
P.O. Box 3621
Portland, OR 97208

Help Available: Speakers, publications and films

National Science Teachers Association
1742 Connecticut Avenue, N.W.
Washington, D.C. 20009

Contact Person: John M. Fowler, Project Director

Help Available: Curriculum materials, guidebooks, publications

U.S. Department of Energy
Seattle Region X
915 Second Avenue
Seattle, WA 98174

Help Available: Publications, films, regional programs of grants technical aids etc.

Federal/National Help (cont.)

Technology Information Center
Box 62
Oak Ridge, TN 37830

Help Available: Referrals, publications

Energy and Education Action Center (202) 472-7777
U.S. Office of Education
Room 514, Reporter's Building
300 7th Street, S.W.
Washington, D.C. 20202

Contact Person: Dr. Wilton Anderson

Help Available: Conferences, seminars, workshops for teachers
Coordination & clearinghouse action for programs

National Solar Heating and Cooling Information Center
P.O. Box 1607
Rockville, MD 20850

Help Available: Provides bibliographies, reading lists, bulletins, all dealing with Solar information

Director, Division of Vocational and Technical Education
Bureau of Occupational and Adult Education
Office of Education
Washington, D.C. 20202 (202) 245-3488

Help Available: Provides grants to state agencies to further maintain, extend, and improve programs

Office of Community & Program Coordination
Department of HUD
Washington, D.C. 20410 (202) 755-6234

Contact Person: Melvin Wachs

Help Available: Technical assistance programs, grants through state agencies to aid in retro-fits, planning

2. Bibliographies Available/ Resource Guides

Besides the sources listed previously, many of which offer bibliograhies in their special areas, several other sources of general energy

Bibliographies Available, (cont.)

Bibliographies exist. This is only a very brief list:

Oregon State University Press, Corvallis, Oregon
Energy -- A Scientific Technical and Socio-Economic Bibliography

National Science Teachers Association
Alternative Energy Sources: A Bibliography

Energy and Education Action Center
Energy: An Annotated Bibliography of Selected Energy Education
This is an excellent comilation for HEW, many sources

EARS -- Environmental Action Reprint Service
Box 545
La Veta, Colorado 81055
Energy Catalog # (most recent)
Superb source of books and periodicals

3. Useful books and articles related to school district energy use, conservation and energy education.

Anderson, Calvin E., School Plant Energy Task Force Plan for Conservation: The Team Approach, Colorado Department of Education, 201 E. Colfax Avenue, Denver, CO , 80203. A step-by-step guide to energy conservation in district school buildings.

Fowler, John W., Energy-Environment Source Book. National Science Teachers Association, 1742 Connecticut Avenue, N.W., Washington, D.C., 20009, 1975.($4.00)

Friend, Gill and David Morris, Kilowatt Counter -- A Consumer's Guide to Energy Concepts, Quantities, and Uses. Alternate Sources of Energy Rt. #2, Box 90A, Milaca, MN, 98009. Useful information that defines energy usage, measurement, conservation, and loss. Includes an explanation of alternate energy sources and definitions.

Massachusetts Department of Education, Approaches to the Conservation of Energy in the Public Schools, Massachusetts Department of Education 31 St. James Avenue, Boston, MA, 02110, 1975. (free) Features five booklets on energy conservation in public schools. Includes activities, information, and bibliographies.

Michigan Association of School Administrators, Energy Conservation: Guidelines for Action. Michigan Association of School Administrators, 421 West Kalamazoo, Lansing, MI, 48933, 1974. ($.75) Provides teacher guidelines for the study of energy conservation. Student activities at all grade levels.